Continental J. Animal and Veterinary Research 3 (1): 22 - 32, 2011 ISSN: 2141 – 405X

http://www.wiloludjournal.com
Printed in Nigeria

# CARCASS YIELD, GUT MORPHOLOGY, REPRODUCTIVE TRACT MORPHOMETRY AND SOME BIOCHEMICAL CHARACTERISTICS OF SERUM IN FEMALE RABBITS FED CASSAVA PEEL MEAL BASED DIETS

P.O.Ozung[1], I.I.Bitto[2] and S.A.Ikurior[3]
[1]Department of Animal Science, University of Calabar, P.M.B 1115, Calabar, Cross River State, Nigeria
[2]Department of Animal Breeding & Physiology and [3]Department of Animal Nutrition, University of Agriculture, P.M.B 2373, Makurdi, Benue State, Nigeria

ABSTRACT
Twenty female crossbred rabbits between the ages of 9-11 weeks old and weighing 1060±85.33g were used to examine the effect of replacing different levels of dietary maize with sun dried cassava peel meal (CPM) as energy source on carcass yield, gut morphology, reproductive tract morphometry and some biochemical characteristics of serum in female rabbits. The animals were divided into four groups designated as 1, 2, 3 and 4 and allotted to four dietary treatments formulated with 0%, 25%, 50% and 75% sun dried cassava peel meal respectively. Results obtained from the study showed that slaughter weight, dressed weight and dressing percent were not significantly ($p>0.05$) affected by dietary treatments. Weight of the heart, liver, lungs/trachea, kidneys and adrenals were also not affected significantly ($p> 0.05$) by treatments. The weight of the spleen and pancreas decreased significantly ($p< 0.05$) with the replacement of CPM in the diets. Weight of the gastrointestinal tract and segments showed a fluctuating trend with no significant ($p> 0.05$) effect with increasing levels of CPM replacement. Weight of the whole reproductive tract and paired uterine horns recorded a fluctuating trend with no significant ($p> 0.05$) effect by dietary treatments. Total protein concentration of tubal fluids did not record any trend and were not significantly ($p> 0.05$) affected by dietary treatments. The serum total protein concentration increased significantly ($p< 0.05$) as the level of CPM increased in the diets. The results of this study show that sun dried CPM can be replaced in diets of female rabbits up to 75%, with no adverse effect on carcass yield, gut morphology, reproductive tract morphometry and serum total protein concentration.

KEY WORDS: Cassava peel meal, carcass, gut, reproductive tract, serum

## INTRODUCTION

The domestic rabbit (*Oryctolagus cunniculus*) is an important non-ruminant herbivore for meat production. Rabbit meat is a source of healthful food as it is low in cholesterol, 50g/100g; fat, 4g/100g; energy, 124kcal/100g but high in protein, 22g/100g (Aduku and Olukosi, 1990). The potential of rabbit meat as a good source of animal protein for human beings has been well documented (Feteke, 1985; Aduku *et al.,* 1991). Rabbits are produced for meat, research, and wool and as pets for hobby. The National Research Council (NRC, 1977) stated that meat production is the most important aspect of rabbit production.

Over the years, the rearing and production of rabbits and other livestock species have been faced with the challenges of feeding and feed availability. Most of the conventional feedstuffs are highly competed for by man, hence the need to source for cheaper but readily available feedstuff so as to mitigate the above challenges. One of such feedstuffs consumed by rabbits is cassava peel meal (Omole and Ajayi; 1986). Cassava peel meal is an emerging and non-conventional feedstuff for rabbits (Aduku and Olukosi, 1990). It could serve as a cheap source of energy for farm animals but should be fortified with additional protein source because of its low protein level (Obioha and Anikwe, 1982).

Cassava peels contain 5% crude protein, 5.8% crude fat, 9.5% crude fibre, 7.2% ash and 2036kcal metabolizable energy (Aduku, 1993). The peels contain two major cyanogenic glucosides, linamarin and Lotaustralin (Njike, 1979). However, sun drying for seven days reduces the content of these toxic factors to safety margins (Atteh, 2002).

Reports on the effect of cassava peel meal on growth performance, nutrient digestibility and carcass characteristics of rabbits abound in literature (Omole and Sonaiya, 1981; Omole and Onwudike, 1982; Agunbiade *et al*. 2001, 2002). However, the effect of sun dried cassava peel meal on carcass yield, GIT morphometry, reproductive potential and serum biochemistry of female rabbits has not been fully investigated.

This study was therefore designed with the objectives of evaluating the carcass yield, gut morphology, reproductive tract morphometry and some biochemical characteristics of serum of female rabbits fed sun dried cassava peel meal based diets.

## MATERIALS AND METHODS

### Location of Study:

The study was carried out at a standard rabbitry in Makurdi, the capital of Benue State, North Central Nigeria. According to Kogbe *et al.* (1978), Makurdi is located on longitude $8^0$ $31^1$ East and latitude $7^0$ $45^1$ North; 90metres above sea level. Makurdi has a tropical climate with distinct wet (rainy) and dry seasons.

### Experimental Animals and Management:

Twenty (20) female crossbred rabbits between the ages of 9-11 weeks old and weighing 1060±85.33g were used for the study. The rabbits were sourced from commercial rabbit farmers in Makurdi town. Anti-stress vitalites were administered via clean drinking water to the animals on arrival. The rabbits were also dewormed using piperazine (liquid) and given a dose of Ivomec medication against ecto-and endo-parasites.

### Housing and Equipment:

The animals were housed in wooden cages measuring 63.50cm X 63.50cm X 63.50cm and raised 25.0cm from ground level as outlined by Fielding (1991). The cages were thoroughly washed and disinfected with saponated cresol (Izal) and allowed to dry for 7 days before the animals were brought in. The wooden cages were roofed with corrugated sheets, over which a grass thatch shade was constructed to keep out direct sunlight and lower ambient temperature. Feed and water troughs were provided in each cage. The rabbits were caged individually in clearly marked cages and provided with a weighed amount of feed and clean drinking water daily. They were allowed to acclimatize for two (2) weeks on the control diet before the commencement of the feeding trial, which lasted for ten weeks (70 days).

### Feed Ingredients, Sources, Processing and Chemical Analysis:

Cassava peels were collected from gari processing locations in Makurdi, washed and sun dried for seven rain free days before they were crushed with a hammer mill for replacement in the test diets. Cassava peel meal served as the test ingredient while the major feed ingredients were maize, full fat soybean, rice husks and brewers dried grains. All feed ingredients were sourced from Makurdi town. Rice husks and full fat soybean were used as the main sources of fibre and protein respectively. Sucrose was added in equal amount to the diets, so as to improve palatability. The proximate chemical composition of sundried cassava peel meal and major feed ingredients (Table 2) were determined using the A.O.A.C. (1984) methods.

### Experimental Diets:

Four (4) experimental diets were formulated containing sundried cassava peel meal (CPM) at O%, 25%, 50% and 75% sundried CPM respectively. The dietary treatments were designated as 1, 2, 3 and 4 respectively. Treatment 1 served as the control diet. The gross composition of experimental diets is presented in Table 1. The chemical analysis of experimental diets was done as outlined by A. O. A. C. (1984).

### Experimental Design:

Animals were assigned to the test diets using a completely randomized design (CRD). Five rabbits were randomly allotted to each dietary treatment, with each rabbit serving as a replicate after balancing for body weight.

### Experimental Procedure:

#### Feeding of Animals/ Feed Intake:

Each rabbit was offered a weighed amount of feed daily. The rabbits were fed in the morning hours between 7: 00 - 8: 00am. The animals had access to fresh and clean drinking water always. Left over feed was collected into clearly labeled envelopes and weighed with a digital scale (Mettler -minimum sensitivity of 0.1g). The feed intake was computed by deducting from the quantity served, the weight left over.

Weighing of Animals / Body Weight Changes:
The rabbits were weighed individually at the beginning of the study and weekly thereafter using a sensitive weighing scale. Body weight changes were determined by difference.

Feed Conversion Ratio:
Feed conversion ratio was calculated as the ratio of feed intake (g) to live weight gain (g).

Slaughtering, Blood Collection and Carcass Evaluation:
At the end of the feeding trial, which lasted for ten (10) weeks, sixteen (16) rabbits (four per treatment) were taken to the laboratory and sacrificed by stunning and followed by severing of the jugular vein as described by Aduku and Olukosi (1990); after they had been starved of feed for twelve (12) hours but had access to adequate drinking water. Each rabbit was weighed before slaughtering. Blood samples per rabbit were collected in clean test tubes without anticoagulant for serum total protein determination. Evisceration and singeing were done as outlined by Aduku and Olukosi (1990). The dressed weight of each eviscerated carcass was recorded.

Dressing Percentage: The dressing percentage was obtained as the percent of the ratio of the empty carcass weight (excluding the head) to the slaughter live weight.

$$\text{Dressing Percentage} = \frac{\text{Dressed weight}}{\text{Slaughter weight}} \times \frac{100}{1}$$

Visceral and Endocrine Organ Weights and Lengths:
The weights of the liver, heart, lungs/trachea, spleen, pancreas, kidneys and adrenals were obtained as outlined by Omole (1977). Segments of the gastro-intestinal tract like the oesophagus, stomach, small intestine, colon, caecum and entire GIT were weighed and their respective lengths determined with a Mettler Toledo scale (with a minimum sensitivity of 0.1g) and a measuring tape respectively. The length of the caecum was taken from the *ileo-caeco-colic* junction to the point where the appendix begins. The organ weights were expressed as percentage of the eviscerated carcass weights, while the lengths of the GIT segments were expressed as percentage of the total GIT length.

Reproductive Tract Morphometry:
Each rabbit was dissected and the reproductive tract obtained *intoto* immediately after slaughter, trimmed of fats and adhering tissues and subjected to morphometric analysis as described by Bitto *et al.* (2006). All weights were determined using a sensitive balance (Mettler PM 2500 delta range with a minimum sensitivity of 0.001g and maximum of 2100g) while linear measurements were obtained with a measuring tape and a glass rule respectively.

Tubal Fluid Flushing:
Immediately after the morphometric analysis, the vagina, cervixes, uterine horns and oviducts were flushed with 0.154M NaCl (Normal saline) as reported by Egbunike and Adegunle (1980).

Determination of Total protein:
Total protein was determined by the method of Weighselbaum (1946) as outlined by the Boehringer Mennhein (Germany) Diagnostica (1979).

Statistical Analysis:
Results obtained from the study were subjected to the one way analysis of variance (ANOVA) as described by Steel and Torrie (1980) for completely randomized design (CRD). Means were compared where applicable using Duncan Multiple Range Test (DMRT).

RESULTS

Table 1: Gross Composition of Experimental Diets

| Ingredients | Dietary treatments 1 Levels of 0% | 2 Cassava peel Meal 25% | 3 Replacement 50% | 4 75% |
|---|---|---|---|---|
| Maize | 50.00 | 37.50 | 25.00 | 12.50 |
| Cassava Peel Meal | 0.00 | 12.50 | 25.00 | 37.50 |
| Full fat Soybean | 20.00 | 25.00 | 26.00 | 30.00 |
| Rice husk | 15.00 | 15.00 | 14.00 | 13.00 |
| Brewers Dried Grains | 11.65 | 6.65 | 6.65 | 3.65 |
| Bone Meal | 3.00 | 3.00 | 3.00 | 3.00 |
| Min. Vit. Premix | 0.1 | 0.1 | 0.1 | 0.1 |
| Salt | 0.25 | 0.25 | 0.25 | 0.25 |
| Sucrose | 0.10 | 0.10 | 0.10 | 0.10 |
| Total | 100.00 | 100.00 | 100.00 | 100.00 |
| Cal. Crude protein (%) | 16.34 | 16.42 | 16.18 | 16.30 |
| DE (Kcal/Kg)* | 2,822.67 | 2,712.92 | 2,555.77 | 2,438.52 |
| Calcium | 1.20 | 1.20 | 1.21 | 1.21 |
| Phosphorus | 0.78 | 0.75 | 0.72 | 0.69 |
| Lysine | 0.71 | 0.75 | 0.75 | 0.78 |
| Methionine | 0.28 | 0.25 | 0.23 | 0.21 |

* Digestible energy (Kcal/Kg), calculated from energy values of feedstuff obtained from nutrients composition Tables, Obioha (1992), Aduku (1993) and Esonu (2000). Guaranteed analysis of Advit super indicate the under listed composition for each Kg: Vitamin composition: Vitamin A, 10,000 000 I .u; Vitamin $B_1$), 75g; Vitamin $B_2$, 2- 5g; Vitamin $D_3$, 2, 000,000 i.u, Vitamin $B_{12}$,), 0.15g; Vitamin $K_3$, 2.50g; Vitamin E, 25.0g; Nicotinic acid 25.0g; Calcium pantothenate 12.50g; Biotin 0.050g; Folic acid 1.0g; Choline chloride 250.0g. Trace minerals: Cobalt 0.40g; Copper 8.00g, Iron 32.g; Iodine 8.0g; Manganese 64g, Zinc 40g Others: Flavomycin 100g; Spiramycin 5g; 3- nitro 50g; DL- Methionine 50g, L-lysine 120g, Selenium 0.16g and BHT 5.00g.

Table 2: Proximate Chemical Composition of Sundried Cassava Peel Meal, Maize, Full fat soybean, Rice husks and Brewers dried grains (% dry matter basis)

| Ingredients | Crude Protein | Ether Extract | Crude Fibre | Ash | NFE | DE* (Kcal/kg) |
|---|---|---|---|---|---|---|
| Cassava Peel meal | 4.06 | 5.36 | 8.77 | 6.65 | 60.46 | 2030 |
| Maize | 8.16 | 3.97 | 2.52 | 1.32 | 71.08 | 3440 |
| Full fat Soybean | 36.75 | 17.33 | 9.34 | 4.83 | 23.91 | 3310 |
| Rice husks | 7.25 | 8.40 | 23.97 | 10.25 | 18.69 | 1400 |
| Brewers Dried Grain | 19.69 | 10.64 | 10.58 | 3.49 | 15.62 | 1980 |

NFE: Nitrogen Free Extract

DE*(Kcal/Kg): Digestible energy, values obtained from Nutrients Composition Table by Esonu (2000).

Table 3: Carcass Yield of Female Rabbits Fed Varying Dietary Levels of Cassava Peel Meal and Maize (x ± sem.)

| Parameter | Levels of Cassava Peel Meal 0% | 25% | 50% | 75% |
|---|---|---|---|---|
| Slaughter Wt. (g) | 1974.10±69.45 | 1801.23±129.51 | 1701.95± 81.69 | 1775.68±108.34 |
| Dressed Wt. (g) | 1198.60±61.27 | 1095.00±103.23 | 1037.85±49.60 | 1108.50± 73.22 |
| Dressing Percentage (%) | 60.65±1.59 | 60.48±1.56 | 60.98±0.19 | 62.39±1.22 |
| Heart (g) | 3.90±0.18 | 3.85±0.39 | 4.15±0.33 | 3.63±0.27 |
| Heart (%) | 0.33±0.02 | 0.35±0.04 | 0.40±0.03 | 0.33±0.02 |
| Liver (g) | 33.48±0.55 | 31.53±3.46 | 31.05±1.16 | 30.53±3.13 |
| Liver (%) | 2.80±0.05 | 2.88±0.32 | 2.99±0.11 | 2.76±0.28 |
| Spleen (g) | 0.80±0.08[a] | 0.55±0.09[b] | 0.48±0.05[b] | 0.55±0.06[b] |
| Spleen (%) | 0.07±0.01 | 0.05±0.01 | 0.05±0.01 | 0.05±0.01 |
| Lungs/trachea (g) | 10.38±0.58 | 10.85±1.08 | 11.45±0.67 | 11.05±1.13 |
| Lungs/Trachea (%) | 0.08±0.05 | 0.99±0.09 | 1.10±0.07 | 1.00±0.10 |
| Pancreas (g) | 22.78±1.42[a] | 22.35±4.78[a] | 13.45±1.56[b] | 13.28±1.72[b] |
| Pancreas (%) | 1.90±0.12 | 2.03±0.44 | 1.30±0.15 | 1.20±0.16 |
| Left Kidney (g) | 3.78±0.16 | 3.30±0.36 | 3.68±0.13 | 3.30±0.22 |
| Left Kidney (%) | 0.32±0.01 | 0.30±0.03 | 0.36±0.01 | 0.30±0.02 |
| Right kidney (g) | 3.80±0.15 | 3.23±0.32 | 3.50±0.16 | 3.25±0.23 |
| Right Kidney (%) | 0.32±0.01 | 0.30±0.03 | 0.34±0.02 | 0.29±0.02 |
| Paired Kidney (g) | 7.58±0.16 | 6.53±0.34 | 7.18±0.15 | 6.55±0.23 |
| Left Adrenal (g) | 0.18±0.03 | 0.20±0.04 | 0.28±0.03 | 0.20±0.04 |
| Left Adrenal (%) | 0.02±0.03 | 0.02±0.04 | 0.03±0.03 | 0.02±0.04 |
| Right Adrenal (g) | 0.15±0.03 | 0.20±0.00 | 0.25±0.03 | 0.20±0.04 |
| Right Adrenal (%) | 0.02±0.03 | 0.02±0.00 | 0.03±0.03 | 0.02±0.04 |
| Paired Adrenal (g) | 0.32±0.03 | 0.40±0.02 | 0.53±0.03 | 0.40±0.04 |

X: mean
S. E. M: Standard Error of mean
a, b: Means on the same row with different superscripts are significantly different ($p < 0.05$)

Table 4: Gastro - Intestinal Tract (GIT) Morphometry of Female Rabbits Fed Varying Dietary Levels Cassava Peel Meal and Maize (x ± sem)

| Organ Weight | Levels of Cassava Peel Meal Replacement 0% | 25% | 50% | 75% |
|---|---|---|---|---|
| Oesophagus (g) | 1.58±0.09 | 1.43±0.05 | 1.40±0.15 | 1.40±0.29 |
| Oesophagus (%) | 0.13±0.01 | 0.13±0.01 | 0.13±0.01 | 0.13±0.03 |
| Stomach (g) | 18.95±0.75 | 17.95±1.53 | 17.28±1.33 | 16.28±0.64 |
| Stomach (%) | 1.58±0.06 | 1.64±0.14 | 1.66±0.13 | 1.47±0.06 |
| Small intestine (g) | 29.43±4.27 | 36.05±5.63 | 27.28±3.19 | 33.7±3.44 |
| Small Intestine (%) | 2.46±0.36 | 3.29±0.52 | 2.63±0.31 | 3.04±0.31 |
| Colon (g) | 31.15±2.14 | 33.98±2.81 | 30.18±1.76 | 36.83±1.64 |
| Colon (%) | 2.60±0.18 | 3.10±0.26 | 2.91±0.17 | 3.32±0.15 |
| Caecum (g) | 39.13±2. 20$^{a}$ | 35.58±2.08$^{ab}$ | 27.15±2.75$^{b}$ | 27.00±2.84$^{b}$ |
| Caecum (%) | 3.26±0.27 | 3.25±0.19 | 2.62±0.26 | 2.44±0.26 |
| Total GIT (g) | 119.93±6.32 | 117.40±11.41 | 102.18±8.95 | 114.28±7.42 |
| Total GIT (%) | 10.01±0.53 | 10.27±1.04 | 9.85±0.86 | 10.31±0.67 |
| **Linear Measurements**: | | | | |
| Oesophagus (cm) | 10.38±0.51 | 9.73±0.33 | 9.30±0.29 | 8.95±0.38 |
| Oesophagus (% GIT) | 2.03±0.09 | 1.91±0.06 | 1.96±0.06 | 1.86±0.08 |
| Stomach (cm) | 14.75±1.41$^{b}$ | 16.00±0.93$^{a}$ | 18.63±0.94$^{a}$ | 19.55±0.79$^{a}$ |
| Stomach (% GIT) | 2.89±0.28$^{b}$ | 3.15±0.18$^{b}$ | 3.95±0.19$^{a}$ | 4.05±0.17$^{a}$ |
| Small Intestine (cm) | 303.15±10.54$^{a}$ | 303.43±10.93$^{a}$ | 270.63±7.08$^{b}$ | 274.40±4.24$^{ab}$ |
| Small Intestine (%GIT) | 59.40±2.06 | 59.67±2.15 | 57.08±1.50 | 57.91±0.88 |
| Colon (cm) | 133.23±4.27 | 131.60±4.87 | 128.30±0.84 | 128.20±1.15 |
| Colon (% GIT) | 25.10±0.84 | 25.88±0.96 | 27.06±0.18 | 26.57±0.24 |
| Caecum (cm) | 48.88±2.63 | 47.75±2.26 | 47.25±2.22 | 46.38±0.85 |
| Caecum (% GIT) | 9.58±0.52 | 9.39±0.44 | 9.96±0.47 | 9.61±0.18 |
| Total GIT (cm) | 510.38±12.06 | 508.50±1425 | 474.10±7.27 | 482.48±4.27 |

X: Mean
S. E. M: Standard Error of Mean
a, b: Means on the same row with different superscripts are significantly different ($p < 0.05$).
Relative organ weight (%) expressed as percent of empty or eviscerated carcass weight
Linear measurements (as % of total GIT length in centimeters)

Table 5: Effect of Cassava Peel Meal on Female Reproductive Tract Morphometry (X ± sem).

| Organ Weight | 0% | 25% | 50% | 75% |
|---|---|---|---|---|
| Reprod.tract (g) | 8.35±0.81 | 12.50±2.03 | 9.53±1.69 | 7.05±1.74 |
| Reprod. Tract (%) | 0.71±0.09 | 1.13±0.09 | 0.94±0.19 | 0.65±0.17 |
| Vagina (g) | 1.60±0.57$^{b}$ | 3.73±0.65$^{a}$ | 1.48±0.43$^{b}$ | 0.83±043$^{b}$ |
| Vagina (%) | 0.14±0.05$^{b}$ | 0.34±0.04$^{a}$ | 0.15±0.04$^{b}$ | 0.08±0.04$^{b}$ |
| Left uterine horn (g) | 0.73±0.22 | 1.63±0.18 | 0.88±0.30 | 0.73±0.25 |
| Left uterine horn (%) | 0.06±0.02 | 0.11±0.03 | 0.09±0.03 | 0.07±0.02 |
| Right uterine horn (g) | 0.95±0.16 | 1.53±0.18 | 0.90±0.23 | 0.78±0.23 |
| Right uterine horn (%) | 0.08±0.01 | 0.14±0.01 | 0.09±0.02 | 0.07±0.02 |
| Paired uterine horn (g) | 1.68±0.19 | 3.16±0.18 | 1.78±0.27 | 1.51±0.24 |
| Paired uterine horn (%) | 0.14±0.02 | 0.25±0.02 | 0.18±0.03 | 0.14±0.02 |
| Left oviduct (g) | 0.25±0.03$^{ab}$ | 0.35±0.06$^{a}$ | 0.19±0.05$^{b}$ | 0.18±0.03$^{b}$ |
| Left oviduct (%) | 0.02±0.00 | 0.03±0.01 | 0.02±0.01 | 0.02±0.00 |
| Right oviduct (g) | 0.28±0.03$^{a}$ | 0.30±0.04$^{a}$ | 0.15±0.03$^{b}$ | 0.15±0.03$^{b}$ |
| Right oviduct (%) | 0.03±0.01 | 0.03±0.01 | 0.02±0.01 | 0.02±0.01 |
| Paired oviduct (g) | 0.53±0.03$^{a}$ | 0.65±0.05$^{a}$ | 0.34±0.04$^{b}$ | 0.33±0.03$^{b}$ |
| Paired oviduct (%) | 0.05±0.01 | 0.06±0.01 | 0.04±0.01 | 0.04±0.01 |
| Left Infundibulum (g) | 0.15±0.03 | 0.23±0.03 | 0.13±0.03 | 0.13±0.03 |
| Left Infundibulum (%) | 0.02±0.00 | 0.02±0.01 | 0.01±0.00 | 0.01±0.00 |
| Right Infundibulum (g) | 0.15±0.03$^{b}$ | 0.28±0.03$^{a}$ | 0.15±0.03$^{b}$ | 0.11±0.03$^{b}$ |
| Right Infundibulum (%) | 0.02±0.01 | 0.03±0.01 | 0.02±0.01 | 0.01±0.00 |
| Paired Infundibulum (g) | 0.30±0.03 | 0.51±0.03 | 0.28±0.03 | 0.24±0.03 |
| Paired Infundibulum (%) | 0.04±0.01 | 0.05±0.01 | 0.03±0.01 | 0.02±0.00 |
| **Linear Measurements (cm unless stated otherwise):** | | | | |
| Vagina | 13.25±2.49 | 10.80±0.97 | 10.75±0.78 | 14.05±3.65 |
| Left uterine horn | 13.38±1.52 | 13.50±1.02 | 12.73±1.16 | 14.50±2.47 |
| Right uterine horn | 14.00±1.67 | 12.65±0.85 | 13.75±1.49 | 13.63±1.39 |
| Left oviduct | 9.25±1.25 | 8.38±0.72 | 7.00±0.54 | 6.25±1.13 |
| Right oviduct | 9.63±0.97$^{a}$ | 6.70±0.71$^{b}$ | 8.38±0.88$^{ab}$ | 5.83±0.72$^{b}$ |
| Left ovary (mm) | 3.10±0.23 | 2.95±0.51 | 1.88±0.43 | 2.10±0.39 |
| Right ovary (mm) | 1.58±0.22 | 1.93±0.01 | 2.38±0.24 | 2.11±0.52 |
| Left Infundibulum (mm) | 2.88±0.47 | 2.38±0.13 | 1.73±0.46 | 2.18±0.35 |
| Right Infundibulum (mm) | 2.38±0.24 | 2.38±0.13 | 3.10±0.29 | 2.63±0.43 |

X: Mean, S. E. M: Standard Error of Mean, a, b: Means on the same row with different superscripts are significantly different ($p < 0.50$).

Table 6: Total Protein Concentration (mg/ 100ml) in Serum and Tubal Fluids of Female Rabbit Fed Varying Dietary Levels of Cassava Peel Meal and Maize (x ± s.e.m.)

| | Dietary Treatments | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | 4 |
| Parameter | Levels of Cassava Peel Meal Replacement | | | |
| | 0% | 25% | 50% | 75% |
| Serum | 7.84±0.17[b] | 10.02±0.69[ab] | 12.40±1.54[a] | 12.07±0.71[a] |
| Vagina | 0.52±0.14 | 1.19±0.32 | 1.00±0.38 | 0.55±0.11 |
| Cervix | 0.76±0.21 | 0.99±0.29 | 0.95±0.08 | 0.82±0.25 |
| Left Oviduct | 0.34±0.09 | 0.72±0.21 | 0.95±0.39 | 0.63±0.15 |
| Right Oviduct | 0.63±0.21 | 0.57±0.08 | 0.86±0.17 | 0.86±0.17 |
| Paired Oviduct | 0.97±0.15 | 1.29±0.15 | 1.81±0.28 | 1.49±0.16 |
| Left Uterine horn | 0.95±0.29 | 1.33±0.11 | 1.00±0.19 | 1.24±0.57 |
| Right Uterine horn | 0.72±0.09 | 1.20±0.10 | 1.48±0.40 | 1.71±0.76 |
| Paired Uterine horn | 1.67±0.15 | 2.53±0.11 | 2.48±0.30 | 2.95±0.67 |

X = Mean
S. E. M = Standard Error of Mean
a, b: Means on the same row with different superscripts are significantly different ($P < 0.05$).

## DISCUSSION

The average dressed weight was not significant ($p > 0.05$) between treatments. Dressing percentage fluctuated though not differing significantly ($p>0.05$) with increasing level of CPM in the diets (Table 3). A range of 60.48± 1.56 – 62.39±1.22 percent was recorded for this study (Table 3). This was lower than the 74 percent obtained elsewhere in Nigeria (Aduku *et al.,* 1986). This observed difference occurred because the heads were removed from the roasted carcasses in this study. The head, skin and feet contribute about 10, 11 and 3 percent respectively to the dressing percentage (Aduku and Olukosi, 1990).

The absolute weight of the spleen and pancreas were significantly ($p < 0.05$) higher in female rabbits fed diet 1 than those on diets 2, 3 and 4 respectively (Table 3). The weights of these organs tended to decrease with increasing levels of CPM; thus suggesting an adverse effect of CPM on the spleen and pancreas, though the animals in this study did not show any disease manifestation. The range obtained for absolute weight of the heart, liver, lungs/trachea, kidneys and adrenals were not significantly ($p > 0.05$) affected by dietary treatments (Table 3). When expressed as percentage of the eviscerated carcass, the weight of the heart, liver, spleen, lungs/trachea, pancreas, kidneys and adrenals were not significantly ($p > 0.05$) affected by dietary treatments (Table 3). The range obtained for relative weight of the heart, liver and lungs/trachea are similar to the 0.24-0.26, 3.06 -3.62 and 0.58 - 0.72 percent respectively reported by Onifade and Tewe (1982).

The weight of the oesophagus, stomach, small intestine, colon and total GIT were not significantly ($p > 0.05$) affected by dietary treatment (Table 4). The caecum recorded significant difference ($p < 0.05$) between treatments. The caecum weight decreased in response to increase in CPM replacement, thus, suggesting adverse effect of CPM on caecum weight, which can lead to hypo motility and poor digestibility (De Blas *et al.,* 1986). The caecum and stomach weights were comparable to the results of Aduku and Olukosi (1990) who recorded approximately 25g and 20g for the caecum and stomach respectively. The stomach weight showed a marginal decrease as the level of CPM increased (Table 4). Weight of the small intestine, colon and total GIT fluctuated with increasing levels of CPM in the diets (Table 4). When compared to the findings of Anthony (2002), the weight of the stomach, small intestine and caecum obtained in this study were slightly lower. The difference may be due to difference in weight at slaughter, bulky nature of the diets which might have exerted pressure on these organs to cause increase weight, increased retention time with increase in fibre levels might also be a contributing factor. These factors might have acted adversely to cause a reduction in weight of the GIT segments in this study. The weights of the various GIT segments when expressed as a percentage of the eviscerated carcass weight were not significantly ($p > 0.05$) affected by dietary treatments (Table 4). The values obtained were however similar to the observations of Ortserga (2002) that replaced rice offal with graded levels of melon seed offal in the diets of growing rabbits.

The total GIT length and its segments like oesophagus, colon and caecum were not significantly ($p > 0.05$) affected by dietary treatments (Table 4). However, the length of stomach and small intestine recorded significant difference ($p < 0.05$) between treatments. The stomach length showed a marginal increase as the levels of CPM increased. This may be attributed to the increased fibre levels in the diets that promoted bowel movement and elongation of stomach walls. The small intestine showed a decrease in length with increasing levels of CPM in diet, thus suggesting that residual cyanide might have a sloughing off effect on the walls of the small intestine, thereby affecting its length. The length of small intestine, caecum and colon obtained in this study are comparable to the findings of Aduku and Olukosi (1990) who recorded 330cm, 40cm and 140cm respectively for small intestine, caecum and colon.

When linear measurements were expressed as a percentage of the total GIT length, the oesophagus, small intestine, colon and caecum were not significantly ($p > 0.05$) affected by dietary treatments (Table 4). The stomach length recorded a significant ($p < 0.05$) effect. This could be due to the increased fibre level and ash content of the diets as the levels of CPM replacement increased.

The morphometric characteristics of the female rabbit genitalia were evaluated. Weight of whole reproductive tract, uterine horn (Paired) and paired Infundibulum were not significantly ($p > 0.05$) affected by dietary treatments (Table 5), suggesting that female rabbits fed as high as 75% cassava peel may support normal reproductive processes. Similar findings were recorded by Bitto *et al.* (2006) involving pawpaw peel meal and the reproductive potentials of female rabbits. The weights of vagina and paired oviducts were significantly ($p < 0.05$) affected by dietary treatments, with fluctuating values as the levels of CPM increased in vagina weights and a gradual decline as the level of cassava peel meal increase with respect to the oviductal weights. While the results of the weight of the vagina may not be ascribed to diet as there was no trend, the significant effect of treatments on the weight of the oviduct requires further investigation, as it appears CPM may affect certain physiological processes associated with the oviduct like fertilization.

In terms of linear measurement, the length of the vagina, uterine horns, ovary and infundibulum did not show significant difference ($p > 0.05$) (Table 5). The right oviduct recorded significant difference ($p < 0.05$) in dietary treatments, with fluctuating decrease in length as the level of CPM increased (Table 5). Thus, it could be stated that female rabbits fed CPM had comparative reproductive tract morphometry. This confirms the report of Famunyan *et al.* (1981) who reported that rabbits fed corn or cassava based diets had comparative reproductive, growth and carcass traits.

Serum total protein concentration showed significant difference ($p < 0.05$) between dietary treatments (Table 6). The serum protein concentration showed a marginal increase as the level of CPM increased in the diets, suggesting no adverse effect of CPM on the serum protein. This contradicts the findings of Omole and Onwudike (1982) and Okoye *et al.* (2006) in other biochemical characteristics who recorded no significant ($p > 0.05$) effect in serum thiocyanate and serum cholesterol respectively in rabbits fed up to 50% CPM. This difference could be attributed to the differences in the levels of CPM replacement in the diets. Serum total protein values in the control diet in this present study were similar to the values earlier reported by Bitto and Shindi (1999) for rabbits fed kapok seed meal. Values in the CPM diets were however higher than the corresponding values reported by the same authors. This variation may be due to differences in nutrient availability.

The total protein concentration in the vaginal, cervical, oviductal and uterine horn fluids did not show significant difference ($p > 0.05$) between dietary treatments (Table 6). This suggests that CPM may be safe for the reproductive life of female rabbits. Results obtained in this study are comparable to the observations made by Bitto *et al*. (2006) that fed paw paw meal based diets to female rabbits.

## CONCLUSION

Sun dried cassava peel meal when fortified with protein sources like full fat soybean can support optimum carcass yield, gastro intestinal tract morphology, reproductive potential and serum protein concentration of female rabbits.

## RECOMMENDATIONS

Within the experimental conditions of the present study, the diet 4(75% CPM replacement) appears to have had optimum carcass yield, reproductive and biochemical characteristics compared to the other diets. It may

therefore be recommended that farmers can replace up to 75% sundried cassava peel meal in maize based diets for female rabbits. However, further research may be necessary to investigate the effect of replacing up to 100% sundried CPM and determining the actual level of residual cyanide in sundried CPM as well as ensuring actual mating of these rabbits, so as to ascertain the effect of sundried CPM on actual reproductive processes.

REFERENCES

Aduku, A.O., Aganga, A. A., Dim, N. I. and Okoh, P. N. (1986). The effect of different methods of processing rabbits on carcass yield and quality. *J.Appl. Rabbit Res.*, 9:164 -166.

Aduku, A. O. and Olukosi, J. O. (1990). *Rabbits Management in the Tropics: production, processing, utilization, marketing, economics, practical training, research and prospects.* Living Books GU Publication, Abuja, FCT.

Aduku, A. O., Aganga. A. A., Abdulmalik, M. and Sekoni, A. (1991). Effect of different protein sources and their levels on the reproduction of breeding rabbits. *J. Appl. Rabbit Res*. 14: 30-33.

Aduku. A. O. (1993). *Tropical Feedstuffs Nutrient Analysis Table*, ABU, Zaria.

Agunbiade, J. A., Fasina, O E., Adeyemi, O. A. and Bagbe, S. A. (2001). *Fortified cassava Peel meal in balanced diets for rabbits, In: Proceedings of Nigeria Society for Animal production*. 26th Annual conference, Ahmadu Bello University, Zaria, Nigeria. pp .148- 150.

Agunbiade, J.A., Bello, R.A., Adeyemi, A.O. (2002). Performance Characteristics of Weaner Rabbits fed on Cassava Peel Meal based diets. *Nig. J. Anim. Prod*.29 (2): 171-175.

Anthony, T. A. (2002). Utilization of *Tridax Procumbens* in cassava-based rations by growing Rabbits. M.Sc.Thesis, Department of Animal production, University of Agriculture, Makurdi

A. O. A. C. (1984). *Official Method of Analysis*, 14th edition. Association of Official Analytical Chemists, Washington D. C

Atteh, J.O. (2002). *Principles and Practice of Livestock Feed Manufacturing*, Adlek Publ., Ilorin. 215pp.

Bitto, I.I., and Shindi, A.S. (1999). The Effect of Kapok (*Ceiba pentandra)* based diets on Visceral Organs and some Biochemical Characteristics of Serum in Rabbits. Proceedings of the 4th Anniversary Conferences of Animal Science Association of Nigeria, Sept. 14th, 1999. IITA, Ibadan, Nigeria. pp. 114 – 117.

Bitto, I. I., Arubi, J. A. and Gumel, A.A. (2006). Reproductive Tract Morphometry and some Haematological Characteristics of Female Rabbits fed Pawpaw Meal based Diets. *Afr.J.Biomed. Res*., 9: 199- 204.

Boehringer M. (1979). Diagnostic Assay Manual, Germany.

DeBlas, J. M., Fraga, H. C., Mana, J. and Poirdregez, J. M. (1986). Unit of food evaluation and requirements for commercially grown rabbits. *J. Anim. Sci*. 60 (4): 1021 – 1028.

Esonu, B. O. (2000). *Animal Nutrition and Feeding. A Functional Approach*. Rukzeal and Rukson Associates, Memory Press, Owerri – Nigeria.

Egbunike, G.N. and Adegunle, S.A. (1980). Regional variation in protein and alkaline phosphate content in the genital tract fluid of Porcine females. *American Journal of Veterinary Medicine*, 27: 319 – 329.

Famunyan, R.C., Adegbola, A.A. and Oke, O. H. (1981). The role of palm oil in cassava based rations. Tropical root crops research strategy for the 1980s, (IDRC), Ottawa, Canada, pp.152 – 153.

Feteke, S. (1985). Rabbits feed and feeding with special regard to tropical conditions. *J. Appl.Rabbit Res*.8: 167 – 173.

Fielding. D. (1991). Rabbits. Tropical Agriculturist. CTA Netherlands, 103pp.

Kogbe, G.A., Tokarrkis, A., Ofigguk, D. and Wozny, D.E. (1978). Geology of Makurdi in middle Benue Valley, Sheet 25, Occasional publication, No.5,Dept. of Geology, ABU, Zaria, Nigeria.

Njike. M. C.(1979). Alternative Energy and Protein Sources for Poultry Feeds in Nigeria. Proc. 1st National Seminar on Poultry Production, held at ABU, Zaria, Dec.11th – 13th.

N.R.C. (1977). *National Research Council. Nutrient requirements of rabbits*, N. A.S. 2nd edition, Washington, D.C.

Obioha, F. C. and Anikwe, P. C. N. (1982). Utilization of ensiled and sundried cassava peels by growing swine. *Nutrition Reports International*, 26: 161 – 172.

Obioha, F. C. (1992). *A guide to Poultry Production in the Tropics*. ACENA Publishers Ltd., Enugu, Nigeria

Okoye, F. C., Ugwuene, M. C. and Mbarah, J. U. (2006). Effects of local spices on the utilization of cassava peel meal – based diets by weaner rabbits. *Pakistan Journal of Nutrition* 5 (3): 203 - 205.

Omole, T. A. (1977). Effect of graded levels of copper in the diets of growing rabbits on their performance, carcass and measurements. *Nig. J. Anim. Prod.* 3: 91 -95.

Omole, T. A. and Sonaiya, E.B.(1981). The Effect of Protein Source and Methionine Supplementation of Cassava Peel Meal Utilization by Growing Rabbits. *Nutrition Report International* 23(4): 729-737.

Omole, T. A. and Onwudike, O. O. (1982). Effects of Palm oil on the use of cassava peel meal by rabbit. *Tropical Animal production* 8 (1): 27 – 32.

Omole, T. A., Ajayi, T. (1986). Evaluation of brewers' dried grains in diets of growing rabbits. *J. Appl. Rabbit Res.* 5: 83 – 88.

Onifade, A. A. and Tewe, O. O. (1982). Alternative energy resources in rabbit diets, growth performance, diet digestibility and blood composition. *World Rabbit Science*, 1 (1): 17 – 24.

Ortserga, D. D. (2002). The effect of replacement of rice offal with graded levels of melon seed (*Citrullus vulgaris*) offal on growth performance and carcass characteristics of growing rabbits. M.Sc.Thesis, Federal University of Agriculture, Makurdi, Nigeria.

Steel, R.G.D. and Torrie, J. H. (1980). *Principles and Procedures of Statistics. A Biometrical approach*. 2nd edition, McGraw- Hill Book Co. Inc. New York.

Weichselbaum, T. E. (1946). *Animal Journal of Chemical Pathology*, 16: 40 – 42.

Received for Publication: 17/04/2011
Accepted for Publication: 19/05/2011

Corresponding Author
P.O.Ozung,
Department of Animal Science, University of Calabar, P.M.B 1115, Calabar, Cross River State, Nigeria
E-mail: pascalozung@yahoo.com